In this paper, we consider integrating two important railway optimization problems, in particular the Rolling Stock Scheduling Problem and the Train Unit Shunting Problem. We present two similar branch-and-cut based approaches to solve this integrated problem and, in addition, provide a comparison of different approaches to solve the so-called Track Assignment Problem, a subcomponent of the Train Unit Shunting problem. In this analysis we demonstrate, by way of a counter example, the heuristic nature of a previously argued optimal approach. For the integrated problem we analyze the performance of the proposed approaches on several real-life case studies provided by DSB S-tog, a suburban train operator in the greater Copenhagen area. Computational results confirm the necessity of the integrated approach; high quality solutions to the integrated problem are obtained on instances where a conventional, sequential approach ends in infeasibility. Furthermore, for the considered instances, solutions are typically found within a few minutes, indicating the applicability of the methodology to short-term planning.